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CORRECTIVE ACTION RECOMMENDATION FOR PROJECT COST VARIANCE IN CONSTRUCTION MATERIAL MANAGEMENT

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ABSTRACT: In construction project operation, often there is a project cost variance in terms of the material, equipments, manpower, subcontractor, overhead cost, and general condition. Material is the main component in construction projects. Therefore, if the material management is not properly managed it will create a project cost variance. Project cost can be controlled by taking corrective actions towards the cost variance. The objective of this research paper is to identify the main cause of the cost variance and to recommend the corrective actions. The approach to serve that objective is by conducting surveys to high rise building construction projects in order to identify the cause of project cost variance in material purchasing, and by interviewing experts in order to obtain recommendations in taking corrective actions. Method Analysis used in this research is Delphi method. The result of the research shows that the corrective action towards the variance of the material purchasing cost is actually a preventive action (before process).

KEYWORDS: material management, cost variance, corrective action.

1 INTRODUCTION

The competitive business nowadays especially in construction industry, demands the increasing quality of construction service companies. There are some steps that can be done to improve that quality, for instance, by taking corrective actions in the construction project operation. Those corrective action in the operation phase could be a Project Control system, consist of cost, quality and time. Control of the project cost consists of material cost control, equipments, manpower, subcontractor, overhead cost and general condition. In construction project operation, often there is a project cost variance. One of the most influencing variables in project cost variance is material. Generally, in construction projects, material and equipment are the two major components, which is about 50-60% of the total project cost [1]. Based on the research by Kerridge [2] in 1987, it is found that material cost mostly could spend 60% of the total construction project cost, but this matter is often neglected. As a comparison, in manufacturing, material management cost at that time is budgeted 1% from the total project cost, while in construction; it is only budgeted 0.15%. Because of the ineffective material management at that time, therefore in some cases of office building construction, it causes the increasing amount of time or work delay up to 18% of the expected time, creating a cost variance. Project cost can be controlled by taking corrective actions towards the cost variance.

Materials management is defined as a management system that is required in planning and controlling the quality & quantity of the material, punctual equipment placement, good price and the right quantity as required [3]. While in Kini`s opinion [4], material management is a management system

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that integrates purchasing, shipping and material control from suppliers. Based on those definitions, generally materials management can be defined as a process of planning, executing, and controlling the right source of materials with the exact quality, at the right time and place suitable for minimum cost construction process.

Capability to coordinate and integrate purchasing, shipping and material control from suppliers is required for material cost control [3, 4, 5]. Three important phases that holds the key to a successful materials management are; materials purchasing, materials usage, waste controlling and storage [6]. Cost control is not only to supervise the cost & data from the field, but also to analyze the data to make a corrective action before it is too late [1]. Corrective action needs the ability to make a decision of what steps to be done, to make priority of how to correct the problems, etc. This paper discusses about the main problem of the variance of cost construction materials management and to recommend corrective actions towards that variance. The scope of this research is limited to the variance of the construction material cost in the operation phase of high rise building construction projects in Indonesia, especially in Jakarta-Bogor-Tangerang-Depok-Bekasi (Jabodetabek). The topic of this paper is part of the research to give recommendation of corrective actions for the variance of material management in construction project operations in Indonesia.

2 MATERIAL COST CONTROL

The purpose of project cost control is to get the early detection of any possibility of cost variance from the budget (cost overrun) so that corrective actions can be taken as anticipation. Cost overrun can increase the total project cost and minimize the profit [7]. Material cost is one of the 5 (five) important components of the project cost [8]. It is the main factor in project cost control, and holds an important role in project development & productivity, which the materials control consist of the relation between quality & quantity of the materials, shipping, scheduling and cost.

Based on Veronika`s research [9], the material cost control covers the control of 10 (ten) main steps in materials management, which are: planning & scheduling, organization & personnel, procurement, delivery, quality assistance/quality control (QA/QC), storage and storage facilities, usage, change order, monitoring & control, and other external factors. Material control covers related factors i.e.; quality, quantity, acquisition, schedule and cost. In material control, there are several things require consideration: material purchasing, items checking, stock control, material storage and upkeep, material shipment, and quality assurance/quality control [1, 6, 10, 11]. In control process, the first thing that needs to be done is to monitor the project cost report and to analyze the cost variance [12]. Cost variance by time identifications is divided into 3 layers i.e.; after-process variance which is reactive and after-the-fact (the variance is identified after the variance exist ;before-process variance (the variance is identified before the variance exist), and ;in-process variance (the variance is identified while the variance exist) [8].

According to Johnston [13], Hamzah [14] and Ahuja [15], the main reasons of cost variance in materials management are : overstocked materials, damaged materials, loss of materials, waiting of the materials to arrive in location, frequent moving of materials, inflation, material, changes in buying/purchasing situation starting from the prepared estimation, bulk material, the shortages and changes of materials quantity required, materials inefficiency, stealing and loss, material shipment, work repairing, delay in updating/posting storage system, inaccurate measurement of work location, material off-take, inaccurate estimation of shipment quantity, uneconomic order quantity, poor shipping time, inadequate tools/equipment needed, increasing transportation cost, material over usage in location, choosing the wrong materials, the increasing storage cost, the poor buying ability, delay of payment, and the poor policy in purchasing.

In analyzing the cost variance, we need to identify the main problem first, and then take the corrective actions to eliminate the negative cost variance, so that the performance cost will improve [8].

Corrective actions are needed to fix the cost variance and it depends upon the cause and the effect of the variance which is the difference between realization and planning [16].

3 RESEARCH METHOD

This research is using the qualitative approach, by interviewing some of the experts who have had experience in high rise building construction projects in the greater Jakarta area (Jabodetabek), to obtain recommended corrective actions needed for controlling material cost variance. The variables used in this research consist of: *cause of the variance variable (in materials management)* and *corrective action variable (to anticipate the variance)*. The corrective action taken is referred to the cause and effect of the material cost variance.

The causes of cost variances and their corrective actions in materials management can be grouped into:

- Planning & Scheduling
- Organization & Personnel
- Procurement
- Delivery
- Quality Assistance – Quality Control
- Storage and storage facilities
- Usage
- Change order
- Monitoring and control
- External factors

Corrective action data acquired from the expert are analyzed with Delphi Method. Delphi Method is a qualitative approach used to provide prediction of future incident tendencies. A team of experts acts as information resources. The goal of this method is to combine expertise opinion toward an incident or a problem. Respondent opinion is completed by conducting Delphi Method. Corrective action towards the cause of material cost variance acquired from the expert are summarized and evaluated subsequently.

4 RESULT OF STUDY

Corrective action data required in this research is obtained by performing open-ended interviews where experts give their opinion and solution if material cost variance occurs. Expert's corrective actions are gathered and divided into 2-3 sections, which are handed back using Delphi Method for expert's resolution. Expert gives their opinion by choosing 1 from 2-3 sections of corrective actions. Further more, statistical evaluation is conducted by observing the major priority chosen by the experts. Recommended corrective actions obtained from the study can be grouped as follows:

Table 1. Recommended Corrective Actions for Material Cost Variance

Variable	Cost Variance Causes	Corrective Actions
Planning & Scheduling		
X_1	Poor forecasting of field condition, weather and event in the future	Conducting detailed and perfect surveys towards the field condition and previous weather data
X_2	Poor planning in scope of work	Accurately study the job items, sequences and methods of the job activities
X_3	Poor material scheduling (inaccuracy)	Prepare a detailed materials schedule planning in accordance with scope of work

Variable	Cost Variance Causes	Corrective Actions
X_4	Poor estimation and budgeting of materials cost	Prepare an accurate and detailed budgeting based on direct market surveys
X_5	Poor development and application of the standard work procedure	Evaluate the available standard method in accordance with the scope of work, situation, condition and environment
X_6	Poor market prediction	Conduct a pre survey in accordance with market to enable making the right price estimation
X_7	Poor data and information of activity and materials	Conduct data acquisition to make a good and complete data & information
Organization & Personnel		
X_8	Lack of support from head office	Employ a correct procedure and apply the procedure with high level of discipline.
X_9	Lack of funds	Optimize cash flow in accordance with the requirements.
X_{10}	Ineffective communication system	Planning and applying Management Information System (MIS)
X_{11}	Inefficient system procedure and bureaucracy	Routine evaluation of all procedures to adjust procedures effectiveness and efficiency
X_{12}	Poor decision making process	Conduct routine/regular coordination meeting and develop a procedure regarding decision making.
X_{13}	poor coordination of functions in project organization	Develop a good, simple and easy to understand system to regulate coordination procedures and responsibility of units.
X_{14}	Wrong delegation of authority	Organization must have well defined and well implemented job description which includes responsibilities and roles of each functions.
X_{15}	Wrong placement of personnel in project organization structure	Conduct proper Personnel selection for the position needed based on comprehensive work experience and training check and relevant skill tests.
X_{16}	Poor interpersonal communication ability	Develop an excellent and effective communication system that has a fix procedure.
Procurement		
X_{17}	Scarcity of materials in the market	Utilize material optimization/material substitution and adjust price accordingly based on the material selected.
X_{18}	Changes of materials source condition towards the project location	Propose Material substitution or Material Price adjustment.
X_{19}	Deviation of quality materials purchased and ordered	All clauses regarding procurement must clearly define the responsibilities, rights and penalties.
X_{20}	Delay of materials payment	Develop an excellent payment schedule to prevent delay in material delivery.
X_{21}	Changes of the company purchasing policy	Develop fixed procedure
X_{22}	Deviation of scheduling	Develop detailed and accurate schedule to facilitate easy and controlled scheduled execution.
X_{23}	Poor purchasing strategy in selecting vendors	Conduct comprehensive and careful selection of suppliers, which consider supplier daily capacity and material quality.
Delivery		
X_{24}	Delay of materials shipment to location	Procurement Schedule (including delivery) must be routinely monitored
X_{25}	Changes of materials condition during shipment process	Must have material maintenance procedure during procurement/delivery.
X_{26}	Shipping cost variance	Delivery cost is determined based on budget requirements.
X_{27}	Poor accessibility during shipping process	Must have proper temporary storage facilities.
Quality Assistance / Quality Control		

Variable	Cost Variance Causes	Corrective Actions
X_{28}	Materials quality variance from specification	Conduct quality control check to before delivery to ensure material is up to specification
Storage and Storage Facilities		
X_{29}	High number of stealing in warehouses	Provide state of the art security system to support competent and honest security personnel.
X_{30}	High potency of fire in warehouses	Provide the necessary equipments for storage fire safety and provide training for safety personnel.
X_{31}	Delay of posting in inventory system	Create Storage and facility management, material maintenance procedure and discipline storage unit.
X_{32}	Overstocking materials in warehouses	Create Storage and facility management, material maintenance procedure and discipline storage unit.
X_{33}	High number of materials damage in warehouses	Create good storage system conform to warehouse standards for material storing.
X_{34}	Poor supervision in warehouses	Conduct periodic storage control.
Usage		
X_{35}	Inefficient usage of materials in location	Develop effective material usage procedure and material usage control
X_{36}	High frequent materials movement	Develop accurate material transfer method and adequate temporary facilities site
X_{37}	Frequent rework due to mistakes	Clear design with good material plan contents and according to scope of work
X_{38}	Lack of understanding towards the characteristic of work location	Environmental and site evaluation sequence
X_{39}	Lack of transportation	Provide accurate estimation for mobile equipment plan and placement schedule
X_{40}	Inefficient utilization and cutting of materials	Provide bar bending/ cutting schedule
X_{41}	Wrong materials utilization	Provide clear work method with available facilities
Change Order		
X_{42}	Incomplete drawing design	Develop evaluation during tender explanation meeting
X_{43}	Frequent out-of-sequence job flow	Provide accurate and detail execution schedule
X_{44}	Schedule compression	Perform work according to schedule and identify change of order and adjust accordingly to schedule.
X_{45}	Owner intervention during process	Clear and well defined clauses in contract regarding responsibilities and duties to prevent unnecessary disruption.
Monitoring and Control		
X_{46}	Lack of coordination meeting in the field	Operation that regulate Coordination meeting
X_{47}	Poor report system	Develop procedure and execute the procedure with discipline.
X_{48}	Lack of Information System role (MIS-IT)	Develop appropriate Information system with proper communication procedure.
X_{49}	Poor company's administration and documentation system	Provide Manual and procedure that govern administration and documentation.
X_{50}	Poor evaluation and decision making system	Conduct coordination meeting for project evaluation to reach effective and accurate decision making.
X_{51}	Poor inventory control towards stock of materials	Create a procedure and implement the procedure with discipline.
External Factors		
X_{52}	High number of materials and equipment loss/stealing	Well Implementation of Safety and security system and discipline in material utilization
X_{53}	Frequent changes of economic condition	Periodic evaluation of project. Create addendum to minimize losses and impact from planning if needed.

Variable	Cost Variance Causes	Corrective Actions
X_{54}	Frequent changes of rules and regulations	Make contract changes with binding condition and according to the applicable agreement.
X_{55}	High frequent of unpredictable situations during construction (force majeure, natural disaster, politics, etc)	Include force majeure clausal in contract to predict and anticipate unexpected conditions.
X_{56}	Poor condition of weather and climate	Apply accurate construction method
X_{57}	High competition	Improve effectiveness, efficiency and productivity by implementing SWOT analysis.

5 CONCLUSION

Corrective actions are applied to the causes of variance by observing the risk factor, both the highest and lowest risk factors, in an effort to prevent deviation in material management. Comprehensive understanding of field issues and problems are required before giving corrective actions recommendation. That way, the effect due to the cost variance can be presented in detail and according to the real condition. Expert's recommended corrective actions are corrective actions taken from past events. These actions are preventive actions.

Research shows that the cause of material cost variance, risk ranking and recommended corrective actions can be organized into a knowledge base which can be developed into a computerized *knowledge base management system*. This prototype *knowledge base management system* will yield output in terms of recommended corrective action to cost variance. Recommendation will depend on factors which have the highest risk ranking. Corrective actions towards the cause of variance are recommended by observing the risk level of material cost variance.

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